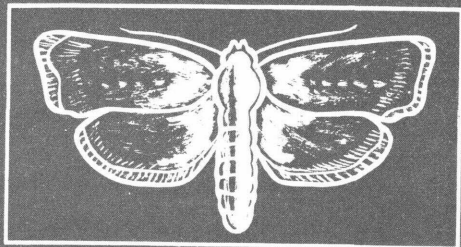


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7984F Revised 2/67
Worm Bull # 2217
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CONTROLLING THE GREATER WAX MOTH

... A PEST OF
HONEYCOMBS

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Controlling THE GREATER WAX MOTH . . . a pest of honeycombs

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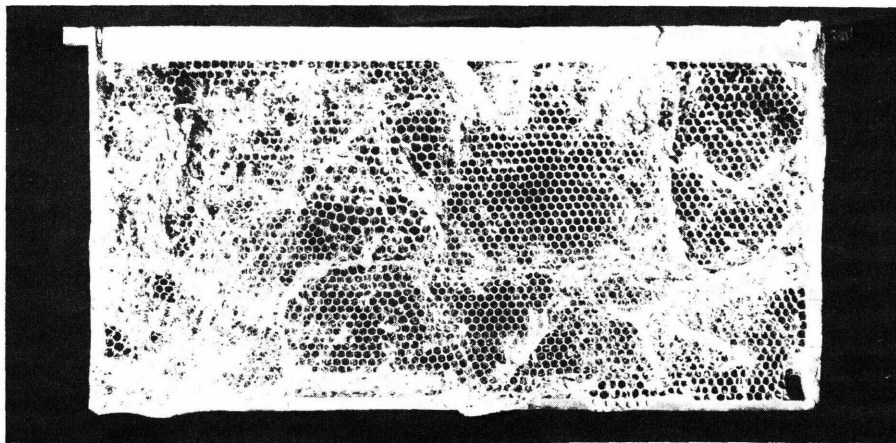
The greater wax moth¹ is also known as the bee moth, the bee miller, the wax miller, and the web-worm. In its larval stage it damages combs and honey and is responsible for large losses to beekeepers in the United States. This insect is found almost everywhere that bees are raised. Its greatest damage is done in the Southern States, where its season of activity is longest.

¹ *Galleria mellonella*.

NATURE OF DAMAGE

The greater wax moth is most destructive to combs in storage, especially to combs stored in dark, warm, poorly ventilated places. The larvae of the moth tunnel into the combs, leaving them a mass of webs and debris.

Greater wax moths sometimes attack combs within the active hive, though such attacks are less common than those on stored combs.



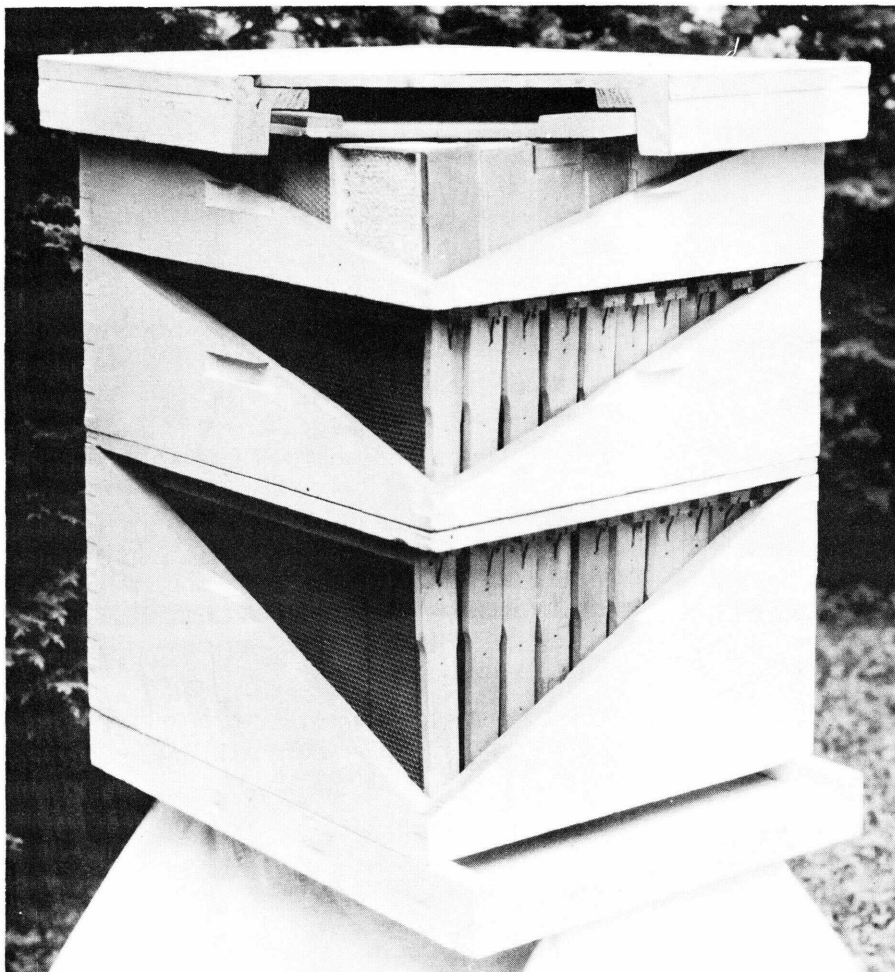
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Brood comb infested with greater wax moth larvae.

If the colony is strong, the bees defend themselves well against attack, and chance of infestation is slight. However, weak, diseased, starved, or otherwise abnormal colonies are a prey of the greater wax moth, and in these colonies the combs are often destroyed. Thus, though greater wax moths may not destroy

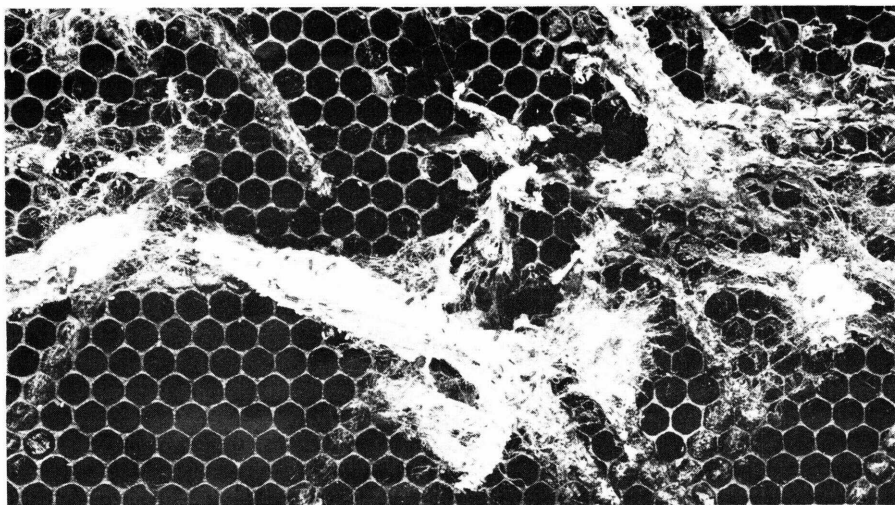
a healthy colony, they may contribute to the destruction of an already weakened colony.

The larvae of the greater wax moth also do considerable damage to comb honey. The eggs are probably laid on the comb or section boxes before the comb-honey supers are removed from the hives,



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A modern hive cut away to show the interior and the placement of movable frames. A full-depth hive body is at bottom; shallow hive bodies are in the middle and at top.



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Part of a comb damaged by the webs and tunnels of greater wax moth larvae.

but the damage does not become evident until some time after the honey has been placed in storage. The damage consists of small, rather inconspicuous tunnels and borings made by the larvae through the thin wax caps of the honey cells. The honey leaks out through these holes, making the affected section unmarketable.

DESCRIPTION AND DEVELOPMENT

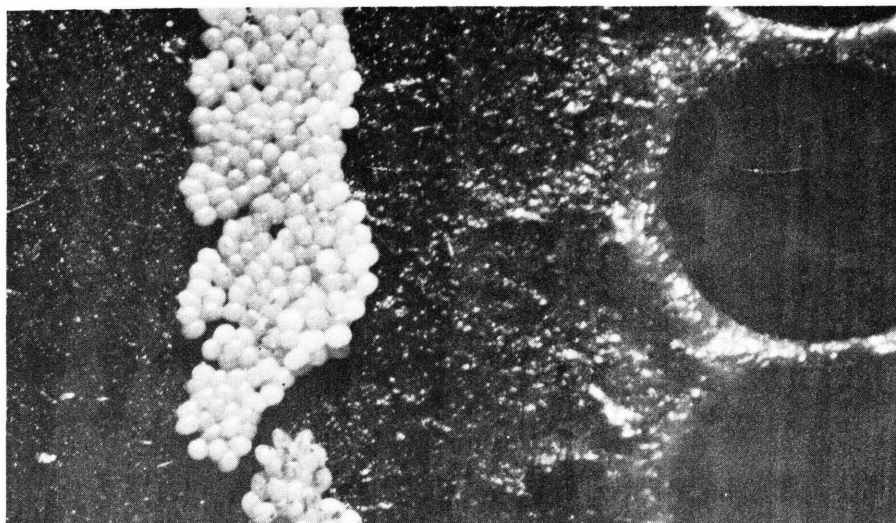
The greater wax moth passes through three stages of development before becoming an adult—egg, larva, and pupa. In the Southern States these stages are not confined to particular times of the year. All stages may be present at any time during the year, and development is continuous except during periods of low temperature.

The Egg

The egg of the greater wax moth is small, white, and slightly oblong; its greatest diameter is less than one-fiftieth of an inch. Normally the female lays eggs in masses rather than singly, but even these masses are usually very difficult to see.

The eggs are laid most frequently in the cracks between hive parts—that is, between supers, between hive body and bottom board, or between top super and cover. The egg masses may be deposited in these cracks from outside the hive or, if the colony is weak, from inside the hive. Egg laying within the hive almost always occurs in places farthest from the light.

At 75° to 80° F. the eggs hatch in 5 to 8 days, but at lower temperatures (50° to 60°) the incubation period may extend to 35 days.



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Eggs of the greater wax moth, laid on a comb. Greatly enlarged.

The Larva

The newly hatched larvae are often seen on the inner covers of hives and in cracks between supers and hive parts. They are white, extremely small, and very active. Almost immediately after hatching they attempt to burrow into the wax. The first attempts often do little more than roughen the surface of the wax; but after the first day, the larvae tunnel into the cell wall and make their way toward the midrib of the comb.

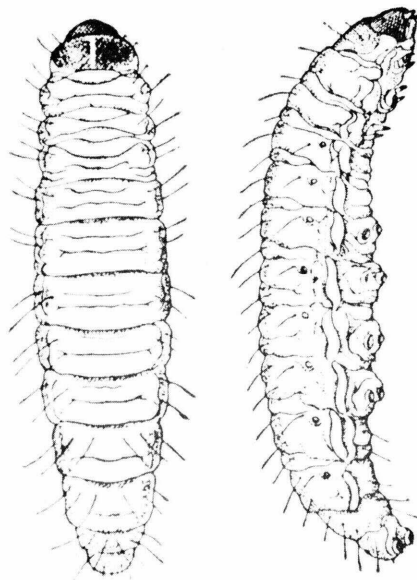
The length of the larval period ranges from 28 days to nearly 5 months. During this period the larvae grow from about $\frac{1}{25}$ inch to as much as $\frac{7}{8}$ inch in length. The rate of growth and final size of the larvae depend chiefly on the food supply and temperature.

The larvae receive most of their

nourishment from impurities in the wax, and in obtaining these impurities they ingest the wax itself. Foundation, which contains less of the impurities than the darker brood combs, is seldom attacked. Small larvae can develop on foundation, but many of them die, and those that survive develop at a relatively slow rate.

It is almost certain that some of the damage attributed to the lesser wax moth (*Achroia grisella*) is the work of these poorly fed greater wax moth larvae (*Galleria mellonella*).

Temperatures most favorable for development of the larvae are between 85° and 95° F.—about those normally found in a beehive during the active season. At lower temperatures growth is retarded; at 40° to 45° no feeding or growth takes place, and the larvae seem to become dormant.



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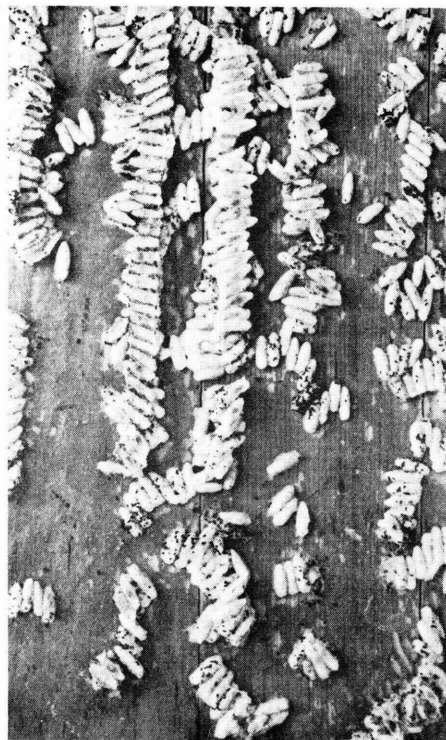
Larvae of the greater wax moth:
Left, dorsal view; right, lateral view.

The Cocoon

When fully grown the larva spins a dense, rough silken cocoon. Some cocoons are found amid the tunnels and webbing in the combs, or in the refuse on the bottom of the hive; but usually the cocoon is firmly attached to some solid support, such as the frame, the side of the hive, or the inner cover. Frequently the larva cements its cocoon inside a cavity that it has chewed in the wood. These cavities sometimes extend completely through the end or top bars of the frame.

The Pupa

Within the cocoon the larva changes to the pupa. The duration of the pupal stage within the cocoon ranges from 8 to 62 days; the



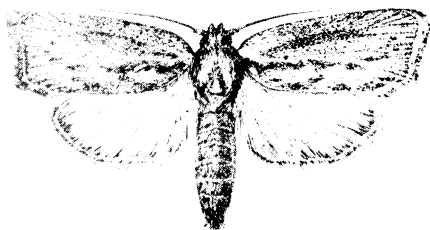
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Cocoons of the greater wax moth.

higher the temperature, the shorter the duration. As with many other insects, the pupal period allows the greater wax moth to pass through the fall and winter protected against harmful weather conditions. In the South, especially in warm winters, the adults may emerge at any time.

The Adult

The normal adult of the greater wax moth is about $\frac{3}{4}$ inch long and has a wingspread of 1 to $1\frac{1}{4}$ inches. The males are slightly smaller than the females and may be distinguished from them by the shape of the outer margin of the fore wing, which is scalloped in the male but smooth in the female.



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Adult female of the greater wax moth.

Adults are commonly seen in the resting position with their grayish-brown wings folded in rooflike fashion. The moths are not easily disturbed, but when molested they run rapidly before they take wing.

The moths vary widely in size and color, according to the type of food consumed by the larvae and the length of the developmental period. Small, poorly nourished larvae, or those whose development is slowed by low temperatures or other influences, transform into small adults; sometimes these adults are less than half the normal size. Larvae that feed on dark brood combs transform into moths that may be dark gray to almost black; those that feed on foundation become silvery-white moths that are smaller than those that fed on brood comb.

The female starts depositing eggs from 4 to 10 days after she emerges from the cocoon; she continues depositing as long as her vitality lasts. Egg laying may be rapid at times; females have been known to deposit more than 100 eggs in 1 minute. The total number of eggs laid by a female varies considerably, but it is usually fewer than 300. The adults may live as long as 3 weeks.

OTHER COMB-DAMAGING MOTHS

The lesser wax moth (*Achroia grisella*) also does some damage to stored combs. Its larvae inflict damage similar to that of the greater wax moth larvae, but the tunnels are smaller, the webs finer, and feeding and webbing are more confined to the outer surface of the combs.

The larvae of the Mediterranean flour moth (*Ephestia kuehniella*) feed on pollen in the hive, and do some damage to combs by boring tunnels through the midrib. The flour moth larvae also tunnel into brood cells and consume the food intended for the developing bee larvae.

These two moths may be controlled by the methods used for control of the greater wax moth.

CONTROL MEASURES IN THE APIARY

The most effective natural enemies of greater wax moths are the bees themselves. When the colony is strong, the bees will carry the moths out of the hive and prevent any damage by the larvae. It is only when the colony has been weakened—by disease, starvation, or other means—that the wax moth succeeds in seriously damaging inhabited combs. Accidental loss of queens late in the fall may mean the loss of colonies from greater wax moth damage before the first spring inspection.

Therefore, any beekeeping practices or manipulations that help maintain strong colonies will also

decrease the chances of greater wax moth infestation. There is no better insurance against the ravages of the pest than to have strong, queenright colonies.

There is one beekeeping practice that is especially important in preventing greater wax moth infestation—keeping the hive clean. Propolis, bur combs, and refuse should be removed from the bottom board, since they provide protection for larvae of the greater wax moth, even in strong colonies.

CONTROL MEASURES FOR STORED COMBS

When combs are removed from the hive and placed in storage, there is increased danger of damage by the greater wax moth. Steps must be taken to kill any existing stages of the greater wax moth and guard against later infestation. The most satisfactory method of controlling the insect in stored combs is the use of fumigants and the proper storing of the combs after fumigation.

Fumigation of Stored Combs

Fumigants are liquid or solid chemicals that form gases when exposed to the air. These gases kill the adult moths, larvae, pupae, and sometimes the eggs. If the combs are thoroughly aired after fumigation, fumigants do not leave residues that would be harmful to bees.

Paradichlorobenzene and ethylene dibromide used as directed effectively protect stored combs from the

greater wax moth. They are not recommended for use on combs containing honey intended for human consumption. (See "Precautions," p. 12.)

Fumigation with paradichlorobenzene

Paradichlorobenzene (PDB) is a white crystalline substance that evaporates slowly in air. It is most effective at temperatures above 70° F. and volatilizes more rapidly as the temperature rises. The gas is heavier than air, nonflammable, and nonexplosive.

PDB can be used to protect all combs in storage except those containing honey intended for human consumption. The odor of PDB is readily absorbed by honey, and though the bees do not object to this odor, such honey is unfit for market purposes. Stored honey combs protected with PDB can be used for spring feeding as long as the combs are aired for a few hours before being placed on colonies.

Treatment with PDB requires no special storage facilities. The supers should be stacked as tightly as possible, and special precautions should be taken to see that the gas, which is heavier than air, cannot escape at the bottom of the stack. For long periods of storage, as over winter, the cracks between supers should be covered with strips of gummed paper. No more than 5 full-depth supers or 10 half-depth supers should be used in a stack. Taller stacks may not allow for complete diffusion of the heavy gas, especially during periods of low temperature.

In a stack of five 10-frame supers, 3 ounces of the crystals (6 tablespoons) should be sprinkled on the frames of the top super. The crystals may be placed directly on the top bars of the frames or, preferably, separated from the frames by a piece of paper or cardboard. The cover should then be put tightly in place.

At intervals of 2 or 3 weeks the covers of the stacks should be raised and the top supers examined; if crystals are no longer present, more should be added. PDB kills adults and immature stages, but not eggs. The continuous presence of crystals within the stack not only repels moths and prohibits egg laying, but also kills any young larvae that hatch after the combs are placed in storage.

Fumigation with ethylene dibromide

Ethylene dibromide is sold as a heavy clear liquid. It is nonexplosive, nonflammable, and easily stored. On exposure to air it forms a colorless gas that is heavier than air and has a slight, not unpleasant odor. This compound volatilizes and diffuses rather slowly, killing all stages of the greater wax moth, including the egg.

Except when an especially prepared fumigation chamber is available, fumigation should take place out-of-doors, under an open shed, or in a well-ventilated room away from workrooms or workers. As in PDB fumigation, supers should be stacked so that the bottom of the stack and the cracks between supers are as gas-tight as possible. No more than

eight full-depth supers should be placed in a stack.

An absorbent material such as paper towel, cloth, or sacking is placed on the top bars of the frames in the top super, and sprinkled with 1 tablespoon of the liquid fumigant. The cover is then quickly put in place. If the temperature is below 60° F., or if the supers are not tightly stacked, 2 tablespoons per stack of eight supers may be used.

For commercial fumigation of many supers in a relatively airtight room, ethylene dibromide should be used at the rate of 1 pound per 1,000 cubic feet of storage space. The liquid should be sprinkled on top of the stacks, as described above; but in an airtight chamber, covers are not necessary, and stacks may be open at the bottom and slightly raised off the floor to promote circulation of the fumigant.

Fumigation with ethylene dibromide should continue for at least 24 hours, since the gas diffuses slowly, especially at temperatures below 60° F.

Storage

The threat of damage by the greater wax moth to stored combs is continuous, except when temperatures in the storage area drop below 40° F. The presence of PDB in the stacked supers throughout the storage period is a constant check on the greater wax moth; but ethylene dibromide provides better temporary control. Fumigants may effectively destroy all existing stages of the moth, but they may not prevent a later re-infestation.

Therefore, fumigation with these chemicals should be followed by storing the frames in a moth-free room that is clean, well lighted, and ventilated. The supers should be placed on end and spaced to allow air circulation. This will help repel greater wax moths, which like to lay their eggs in dark, poorly ventilated places. The common method of

storing combs in tightly closed, crowded hive bodies is highly favorable for wax moth infestation and development.

The combs should be inspected monthly for signs of infestation. Inspection is especially desirable if temperatures rise above 60° F. and permit wax moth activity.



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Precautions

The fumigants ethylene dibromide and PDB used improperly can be injurious to man and animals. Follow the directions and heed all precautions on the container label. Keep the fumigants well labeled, in a dry place where they will not contaminate food or feed and where children and pets cannot reach them.

Ethylene dibromide requires special care in handling. If the liquid is spilled on the skin, it causes blisters or burns if not washed off immediately. The gas is irritating to the lungs and nasal passages. PDB fumes in high concentrations may

be irritating to the eyes and nasal passages.

Fumigate out-of-doors, or under an open shed, or in a well-ventilated room away from workrooms or workers.

Where large quantities of combs or equipment must be fumigated, wear a gas mask; have someone work with you or watch you; expose yourself as little as possible; and post warning signs to prevent accidental exposure of others.

Do not use ethylene dibromide or PDB on stored combs containing honey intended for human consumption.



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